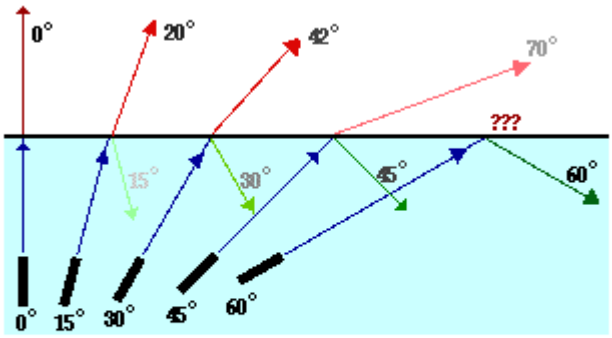
Total Internal Reflection

When light passes through a boundary not all of the light is refracted, some of the light is reflected back into the original medium. As the angle of incidence increases the amount of light reflected also increases. If the material is travelling from an optically denser medium to a less dense one the angle of refraction will be greater than the angle of incidence. As the angle of incidence gets larger the angle of refraction will get even larger. **Eventually the angle of refraction will be 90, the angle of incidence at this point is called the critical angle and at this point an interesting phenomenon occurs.**

As the angle of incidence increases from 0 to greater angles ...



...the refracted ray becomes dimmer (there is less refraction)
...the reflected ray becomes brighter (there is more reflection)
...the angle of refraction approaches 90 degrees until finally a refracted ray can no longer be seen.

Example

Calculate the critical angle of the water / air interface. Express your answer to the correct number of significant figures.

The refractive index of water is 1.33
The refractive index of air is 1.0

Water to Air

$n_1 \sin\theta_1 = n_2 \sin\theta_2$

Critical Angle = ?

$\Rightarrow \quad n_{water} \sin\theta_{water} = n_{air} \sin\theta_{air}$

$1.33 \times \sin\alpha = 1.0 \times \sin 90$

Critical Angle = 49 ° (2sf)